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ALBINO SEEDLINGS OF WHITE SPRUCE

by

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ABSTRACT

In two tests, seed collected from a stand of mature white spruce trees (Picea glauca *(Moench) Voss) produced 1.5 and 1.9 percent albino seedlings. None of the albinos lived more than a few weeks, and all had normal chromosome counts of* 2n=24. *Chlorophyll deficiency is evidently a recessive character, but these observations did not resolve current questions of whether the character is controlled by one or more genes or is linked with an embryonic lethal. The albino seedlings may have resulted from self-fertilization of one or more parent trees.*

Albinism, as well as lesser degrees of chlorophyll deficiency, was reported among gymnosperms in seedlings of eastern white pine *(Pinus strobus* L.) (Johnson 1945), Austrian pine *(Pinus nigra* Arnold) (Johnson 1948), Scotch pine *(Pinus sylvestris* L.) (Eiche 1955), red pine *(Pinus resinosa* Ait.) (Fowler 1962), western white pine *(Pinus monticola* Dougl.) (Barnes *et al.* 1962), slash pine *(Pinus elliottii*

Engelm.) (Squillace and Kraus 1963), jack pine *(Pinus banksiana* Lamb.) (Fowler 1965a), Norway spruce *(Picea abies* (L.) Karst.) (Langner 1953), Serbian spruce *(Picea omorika* (Pancic) Purkyne) (Langner 1959), and blue spruce *(Picea pungens* Engelm.) (Cram 1960). Nienstaedt[1] and Fowler[2] both observed chlorophyll deficiency after selfing white spruce, but neither has yet published his data. This Note reports albinism among seedlings from a wild source of open-pollinated white spruce seed in Alaska.

METHOD AND RESULTS

Cones were collected in August 1968, just prior to seed dispersal from several 180-year-old white spruce trees *(Picea glauca* (Moench) Voss), located approximately 25 kilometers southwest of College, Alaska, at the Bonanza Creek Experimental Forest (64°51'N, 147°44'W). Seeds were extracted and planted the same season.

In two tests, respectively, six albinos were recovered from 400 seeds (1.5 percent) and 17 from among 900 seeds (1.9 percent). The albino seedlings had white cotyledons and pink hypocotyls, but none of the other morphological characters deviated significantly from the variation found in normal seedlings (fig. 1). Most albino seedlings remained alive for 2 or 3 weeks.

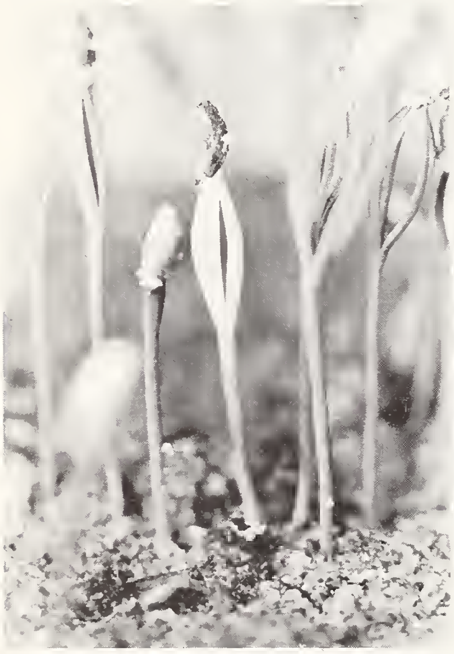

Figure 1.—Albino seedling from Alaskan white spruce seed collected from open-pollinated trees.

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[1] Dr. Hans Nienstaedt, Institute of Forest Genetics, Rhinelander, Wis., personal correspondence.

[2] Dr. D. P. Fowler, Dep. of Fisheries and Forestry, Fredricton, N. B., Canada, personal correspondence.

Eleven albino and four normal seedlings were examined cytologically with a propiono-orcein squash technique, and cells from root and needle meristems from all plants had the normal chromosome number of $2n=24$ (fig. 2).

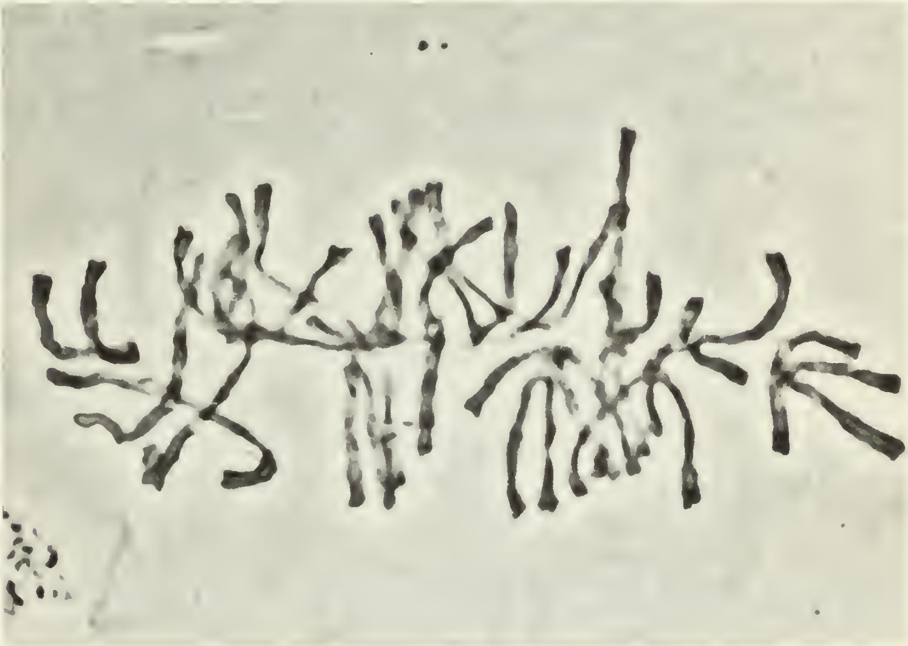

Figure 2.—Somatic metaphase stage in one cell from an albino white spruce seedling, with $2n=24$ chromosomes.

DISCUSSION

The frequency of self-fertility appears to be generally higher among the spruces than the pines. Selfing results in an inbreeding depression for both species. The exception is for red pine (Fowler 1965b), which may be largely homozygous for most alleles. Fowler (1964) reported mutant seedlings in red pine having light yellow-green cotyledons and suggested that they were homozygous for a single recessive gene. He explained the divergence from an expected 1:3 monohybrid ratio as a selection against zygotes, pro-embryos or embryos homozygous for that mutation. Sorensen (1967) suggested that the recessive allele for albinism may be linked with an embryonic lethal. Mergen et al. (1965) reviewed the literature on inbreeding depression from selfing and concluded that it was caused by an accumulation of homozygous alleles in the progeny of heterozygous parents. They went on to give cytological evidence of embryo failure after fertilization but also explained that the degree of embryo failure varied between parent trees. They found no barrier to either self-pollination or self-fertilization in white spruce. They did not report albino seedlings, perhaps because only large seeds were planted.

The albino white spruce seedlings reported in this Note were all devoid of chlorophyll, but their origin is uncertain, whether from one or several parent trees. Total albinism suggests control by one recessive gene. However, the different degrees of chlorophyll deficiency reported among gymnosperms seem to favor an explanation based on a multiple-gene effect. Whatever the genetic control, results of past work by others on selfing indicate that the albino white spruce seedlings may have resulted from self-fertilization and that a low frequency of albinism is common among most wild spruces.

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